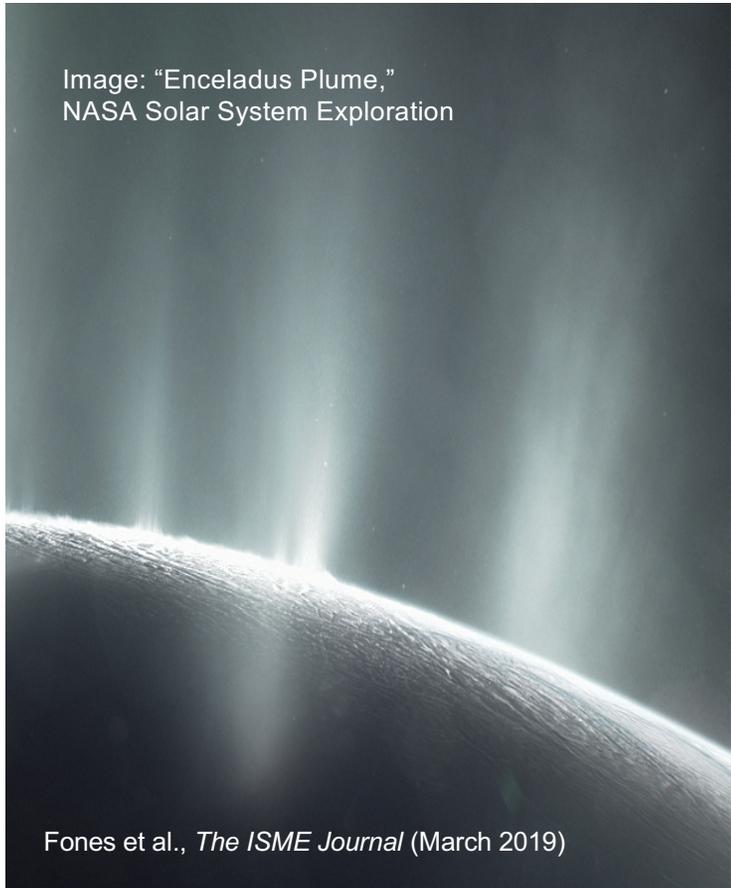


Enceladus on Earth? Life Strategies in Serpentinites

Background | The crust of early Earth was likely ultramafic in composition, similar to Earth's contemporary mantle or the rocky core of Saturn's moon Enceladus. The process of serpentinization (the hydration and metamorphosis of ultramafic rock) can generate hydrogen gas, an electron donor that could have fueled early life on Earth. However, this process also generates high pH and leads to low concentrations of electron acceptors, including inorganic carbon. We examined adaptations of life inhabiting rocks undergoing active serpentinization in the Samail Ophiolite, Oman.

Image: "Enceladus Plume,"
NASA Solar System Exploration



Discovery | Cells living in fluids circulating through the subsurface of the Samail Ophiolite minimize physiological stresses associated with nutrient and energy limitation imposed by serpentinization by:

- (a) Consuming abiotic products of serpentinization including hydrogen and reduced carbon compounds.
- (b) Preferentially assimilating reduced carbon substrates for biomass rather than dissimilating them for energy production.
- (c) Maintaining small genomes to minimize energy and nutrient costs associated with DNA replication and repair.
- (d) Synthesizing proteins comprising more reduced amino acids to minimize energetic costs of protein synthesis and maximize protein stability in highly reducing waters.

Innovation and Impact | This study reveals adaptations that enable life to inhabit fluids emanating from rocks undergoing serpentinization, which in turn could help guide strategies for life detection elsewhere in the solar system.